



J3520-01-01  
June 3, 2022

Ms. Andrea Llamas  
Town of Northfield  
Town Administrator  
69 Main Street  
Northfield, Massachusetts 01360

Re: Preliminary Geotechnical Engineering Recommendations  
Northfield Emergency Services Facilities Project  
Northfield, Massachusetts

Dear Ms. Llamas:

O'Reilly, Talbot & Okun Associates, Inc. (OTO) is pleased to provide this letter report summarizing our preliminary geotechnical engineering recommendations for the proposed Northfield Emergency Services Facility to be located on Main Street in Northfield, Massachusetts. A Site Locus is provided as Figure 1. A Site Plan is provided as Figure 2.

Our preliminary geotechnical recommendations are based upon subsurface conditions observed in seven soil borings and three test pits. Our services consisted of the full-time observation of the borings and test pits, review of the logs and soil samples, engineering analyses, and preparation of this report. This report is subject to the attached limitations.

We note that additional explorations and a review and update to these recommendations will be necessary for final design.

## **PROJECT DESCRIPTION**

The preliminary project design calls for the construction of an approximately 18,000 to 20,000 square feet (footprint) new Emergency Services building. The proposed general location for the new construction consists of vegetated and wooded parcels located off of Main Street and Dickson Street in Northfield, Massachusetts. The property is bounded to the south by the Dickson Street, to the north by wooded parcels, to the west by Main Street, and to the east by Mill Brook.

In general, topography slopes downward from the west (approximate elevation 310 feet) to the northeast (approximate elevation 290 feet). The ground surface in the vicinity of the proposed building area slopes downward from the west (approximate elevation 307 feet) to the east (elevation 296 feet). Wetlands and a stream are located to the north and east of the Site, at an approximate elevation of 290 feet.

The building footprint, slab elevations and structural loads are unknown at this time.

## **PRELIMINARY SUBSURFACE EXPLORATIONS AND TESTING**

Preliminary subsurface investigations consisted of seven soil borings (NE-1 through NE-5, NE-7, and NE-8) and three test pits (TP-1 through TP-3).

### Soil Borings

The borings were performed on April 28 and April 29, 2022 by Seaboard Drilling of Chicopee, Massachusetts. Borings were performed using a track mounted drill rig, using hollow stem auger drilling techniques. Borings NE-1 through NE-3, NE-7 and NE-8 were performed within the proposed building area and were extended to a depth of between 12 and 17 feet. Borings NE-4 and NE-5 were performed within the proposed parking lot areas and were extended to a depth of 12 feet. Proposed boring NE-6 was located within an inaccessible area of the Site and was not completed. Boring locations are shown on Figure 2.

In each of the borings, soil samples were collected continuously from the ground surface to a depth of two feet below ground surface, at a depth of five feet, and every five feet thereafter. Soil samples were collected using a two inch diameter split spoon sampler, driven 24 inches with a 140 pound automatic hammer falling 30 inches (American Society for Testing and Materials Test Method D1586-99 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils"). The number of blows required to drive the sampler each six inches was recorded. The standard penetration resistance, or N-value, is the number of blows required to drive the sampler the middle 12 inches. Soil properties, such as strength and density, are related to the N-value.

An O'Reilly, Talbot & Okun Associates, Inc. (OTO) engineer observed and logged the borings. Samples were classified according to a modified version of the Burmister Soil Classification System. After drilling, bore holes were backfilled with soil cuttings. Boring logs are attached.

### Test Pits

Three test pits (TP-1 through TP-3) were performed on May 11, 2022 by the Northfield Department of Public Works. The test pits were performed within the proposed parking lot areas to observe the nature of near surface soils, examine historic groundwater levels, and/or perform permeability tests. Test pit locations are shown on Figure 2. The test pits were performed using a Takeuchi mini excavator equipped with a 0.5 cubic yard bucket. An OTO field engineer observed and logged each test pit. Test pit logs and photographs are attached.

### Field Testing and Laboratory Testing

#### *Photo-Ionization Detector (PID) Screening*

The headspace of each soil sample collected from the borings was screened using a MiniRAE Lite Photo-Ionization Detector (PID). PID screening provides an assessment of volatile organic content of the samples. PID readings are provided on the attached boring logs.

### Hydraulic Conductivity Testing

In-situ hydraulic conductivity (or permeability) tests were performed in each of test pits using a Guelph Permeameter to aid in the preliminary design of the storm water infiltration system. The Guelph Permeameter allows the rate of water recharged into an unsaturated soil to be measured, while maintaining a constant water head. Calculations are then made to estimate the saturated permeability of the soil for storm water infiltration. The permeability tests were performed by auguring a shallow hole into the soil, adding water to the apparatus and then recording the change in the rate of water flow from a reservoir over time. These data were then used to estimate the coefficient of permeability or hydraulic conductivity.

### Grain Size Analysis

Composite soil samples were collected from the upper five feet of boring NE-3 and NE-7 and grain size analysis were performed by Allied Testing Laboratories of Springfield, Massachusetts. These tests were performed to evaluate the suitability of on-Site soils for use as engineered fill and to supplement the in-situ hydraulic conductivity testing.

## **SUBSURFACE CONDITIONS**

This discussion of subsurface conditions at the Site is based upon published geologic information, general knowledge of the Site location and nearby vicinity, and the soil investigations performed during this study. In general, subsurface conditions consisted of the following, in order of increasing depth: a surface layer of topsoil and silty soils; native granular soils; and glacial till.

### Soil Conditions

Topsoil: Approximately 1 to 10 inches of forest duff was encountered at the ground surface throughout the Site. The forest duff was typically underlain by approximately 5 to 12 inches of topsoil. The topsoil generally consisted of very loose to loose, fine sand, with some amounts of silt, trace amounts of medium sand, coarse sand, fine gravel and trace amounts of organics (roots). Testing for nutrient content, pH, or organic content was not part of this study, and we recommend this testing be performed to evaluate the suitability of existing Site topsoil for reuse.

Granular Soils: Granular soils were encountered beneath the surficial layer in each of the borings. The granular soils consisted of loose to medium dense, fine sand or fine to medium sand with varying amounts of silt, coarse sand, gravel. We note that layers of silty sand were encountered throughout. In test pit TP-3, trace debris (brick) was encountered at 3 feet below ground surface indicating the soils within this area were likely reworked or filled. This layer extended to a depth of approximately eight to ten feet below ground surface. Trace roots were observed to extend to the maximum depth explored in test pit TP-1.

Glacial Till: The granular soils were underlain by glacial till in each of the borings. Glacial till is a very dense, heterogeneous mixture of silt, clay, sand and gravel, and is generally present immediately above bedrock throughout New England. Each of the borings terminated within the dense layer at a depth of between 12 and 17 feet.

### Groundwater Conditions

We note that wetlands are located throughout the property. Groundwater was encountered in borings NE-1, NE-2, NE-4 through NE-8, and test pit TP-1 at a depth of between 3 and 7 feet below ground surface, corresponding to an approximate elevation between 295 and 301 feet. We note that depth to groundwater was measured at the time of drilling at each location, and at 24 hours after drilling in borings NE-1, NE-2 and NE-4. No groundwater was encountered in borings NE-3, NE-5, NE-7 or test pits TP-2 or TP-3. Indications of an estimate high groundwater table (EHGWT) were observed in test pit TP-1 at a depth of five feet below ground surfaced, corresponding to elevation 300 feet. No indications of a EHGWT were identified in the other test pits.

Since groundwater is near the surface at some locations, groundwater control will be a consideration during final design.

### Laboratory and Field Testing Results

#### *Environmental Field Screening*

The headspace of each soil sample was screened using a photoionization detector (PID). PID screening provides an assessment of volatile organic compounds (VOCs) of the samples. The PID readings were below the instrument detection limits. PID readings are presented on the boring logs.

#### *Hydraulic Conductivity Testing*

Hydraulic conductivity (K) testing was performed within the proposed parking areas and potential stormwater management areas using a Guelph Permeameter. The permeability tests were performed in a shallow auger hole within each of the test pits. The test was performed by adding water to the apparatus, and by recording the change in the rate of water flow from a reservoir over time. These data were then used to estimate the coefficient of permeability or hydraulic conductivity.

The tests were performed immediately adjacent to test pits TP-1 through TP-3 at a depth of between three and four feet below ground surface. The soil encountered at the test interval consisted of fine to medium sand with trace amounts of silt and coarse sand. The saturated hydraulic conductivity (K) value determined by these tests, along with the soil conditions, are presented in Table 1.

**Table 1**  
**Hydraulic Conductivity Test Results**

Soil Boring	Test Depth (ft.) / Approx. Elevation (ft.)	Soil Conditions	K Value (feet/day)
TP-1	4 / 301	Fine to medium sand, trace silt, trace coarse sand	52
TP-2	3 / 304	Fine to medium sand, trace silt	11.5
TP-3	3.5 / 303.5	Fine to medium sand, trace silt	12
Note: Elevations presented in this table were developed by referring to a topography survey plan and referring to measurements taken from existing Site features. Data shown in this table should be considered approximate only to the degree implied by the method(s) used.			

Grain Size Distribution

Composite soil samples were collected from the upper five feet of borings NE-3 and NE-7 and analyzed for grain size distribution. In general, each sample was classified as a fine to medium sand with varying amounts of silt, coarse sand, and gravel. Sample NE-3 (0-5') met, and sample NE-7 (0-5') nearly met, recommended characteristics for Granular Fill (18.8 percent passing No. 200 sieve compared to recommended 15 percent). Laboratory data results are attached.

**SIGNIFICANT GEOTECHNICAL ISSUES**

The significant geotechnical issues for the proposed construction addressed in this report include the following: foundation bearing capacity and settlement; seismic design considerations; pavement design; water control; and the suitability of on-Site materials for use as engineered fill.

**PRELIMINARY DESIGN RECOMMENDATIONS**

The following recommendations are provided for the construction assumed in this report. The recommendations in this report refer to the 9<sup>th</sup> Edition of the Massachusetts State Building Code (MSBC). The 9<sup>th</sup> Edition of the MSBC includes amendments to the 2015 International Building Code (IBC).

Site conditions appear to be favorable for the proposed project. The native Site soils were observed to be relatively dense, and no significant amounts of deleterious materials were identified. Preliminary geotechnical recommendations and considerations are provided below. Additional investigations and updated recommendations should be provided during final design.

Foundation Recommendations

The proposed building can be founded on normal spread footing foundations bearing on densified native soils or compacted engineered fill. Provided these recommendations are

followed, a maximum allowable bearing pressure of 4,000 pounds per square foot may be used for preliminary design of exterior and isolated column footings.

Depending on the final design elevation of foundations, silty soils may be encountered. Since these soils are susceptible to disturbance due to their high silt content, we recommend that footing subgrades be over-excavated by six inches and that a minimum of six inches of Crushed Stone be placed upon the native soils to protect the subgrade from disturbance. A non-woven geotextile fabric should be placed between the native subgrade and Crushed Stone. Debris fill encountered below slabs and footings, or wet and/or disturbed soils, should be removed and replaced with either compacted Sand and Gravel or Crushed Stone.

### Concrete Slabs

We recommend that concrete floorslabs bear on at least 12 inches of compacted Sand and Gravel fill (slabs on grade) or Crushed Stone (slabs on grade or basements) to provide uniform support and a capillary moisture break. The subgrade should also be free of large boulders or cobbles, if encountered. We recommend a subgrade modulus of 175 tons per cubic foot (200 pounds per cubic inch) be used for preliminary design of slabs. The Sand and Gravel fill or Crushed Stone beneath the concrete slabs should meet the grain size distribution characteristics outlined in Table 2.

### Lateral Earth Pressures against Below Grade Walls

Static lateral earth pressures will be imposed on below grade walls. These walls should be designed for unbalanced loading conditions. If the walls will be structurally braced, and not free to deflect, and recommend that an equivalent fluid pressure of 55 pounds per cubic foot (pcf) be used. In addition, basement walls should not be backfilled until the first floor slab is installed. If basement or below grade walls are unbraced, they need to be designed to resist overturning, sliding, and bearing capacity failure. For walls that are free to deflect (retaining walls), we recommend an equivalent fluid pressure of 35 pcf be used. A coefficient of friction of 0.45 is recommended to evaluate frictional resistance to sliding along the base of the wall and footings. These values apply to unsaturated soil conditions.

The soil against the outside of basement walls should not be over-compacted, since this would greatly increase lateral loads against the walls. The recommended degree of compaction for engineered fill and compaction means and methods are presented on Sheet 1. We note that these are general guidelines and if it is determined that a location falls into two or more categories, as presented in Table 1-1, the design team should be notified to determine appropriate compaction efforts and/or methods.

### Seismic Considerations

Earthquake loadings must be considered under requirements in Section 1613 and 1806 of the 9<sup>th</sup> Edition (October 2017) of the Massachusetts State Building Code (MSBC). The 9<sup>th</sup> Edition of the MSBC is based upon the International Building Code 2015 (IBC) with Massachusetts amendments. Note that the IBC refers to ASCE-7 (2010), *Minimum Design Loads for Buildings and Other Structures*.



Section 1613 of the IBC covers lateral forces imposed on structures from earthquake shaking and requires that every structure be designed and constructed to resist the effects of earthquake motions in accordance with ASCE-7. Lateral forces are dependent on the type and properties of soils present beneath the Site, along with the geographic location. Per Table 1604.11, the maximum considered earthquake spectral response acceleration at short periods ( $S_s$ ) and at 1-sec ( $S_1$ ) was determined to be 0.179 and 0.069, respectively, for Northfield, Massachusetts.

Soil properties are represented through Site Classification. Procedures for the Site-specific determination of Site Classification are provided in Chapter 20 of ASCE-7. At this Site, we evaluated Site Classification using one of the parameters allowed, Standard Penetration Resistance (N-value). The Site Class was determined to be Class C based upon soil data collected. Furthermore, the Site coefficients  $F_a$  and  $F_v$  were determined according to Tables 1613.3.3(1) and 1613.3.3(2) of the IBC (2015), using both the  $S_s$  and  $S_1$  values and the Site Class. For this Site,  $F_a$  and  $F_v$  were determined to be 1.2 and 1.7, respectively.

Below grade walls should be designed to resist dynamic lateral earth forces in accordance with Section 1610.2 of the MSBC. The seismic earth forces as defined in Section 1610.2 should be applied as an inverted triangle over the height of the wall and added to the static lateral pressures. For purposes of the calculation, a total unit weight of 125 pounds per cubic foot should be used for the backfill against the retaining wall.

Section 1806.4 relates to the liquefaction potential of the underlying soils. The liquefaction potential was evaluated for saturated Site soils, using Figure 1806.4c of the MSBC. Based upon soil densities estimated from N-values and the depth to groundwater, liquefaction is not a concern. Furthermore, it is unlikely that loose soils would be encountered below the maximum depth explored.

#### Groundwater and Surface Water Control

As described above, wet soils were observed in borings NE-1, NE-2, NE-4 through NE-8, and test pit TP-1 at a depth of between 3 and 7 feet below ground surface. Therefore, perched groundwater layers and periods of high groundwater may be encountered during construction and during the service life of the building. Furthermore, infiltration may be limited at this Site due to the low permeability of the silty sand layers and/or underlying glacial till. Therefore, we recommend that preliminary design include drainage systems to prevent the buildup of water along foundations and slabs. The final design of this system should consider building location and slab elevations.

For preliminary design, we recommend that the building include perimeter drainage to control groundwater and surface water infiltration. At this time, we anticipate that the perimeter drainage system would consist of perforated PVC pipe, installed in a Crushed Stone trench, and wrapped in a non-woven geotextile fabric. Furthermore, we recommend that the final design evaluate the need for a Crushed Stone drainage layer beneath the building floor slab once building slab elevations and final Site grades are known.

Furthermore, the contractor should establish and maintain proper drainage of soils during construction. Excavations that extend a short distance into the groundwater table should be dewater using sump pits and pumps.

### Exterior Slabs and Pavements

This section provides preliminary recommendations for exterior entryways, slabs, and sidewalks, as well as flexible and rigid pavements. The significant issue affecting pavement and exterior slab design is the presence of frost susceptible soils at some locations. Given the impermeable nature of the soils (these soils do not provide proper vertical drainage), it is likely that pavement subgrades and bases will become saturated. If the water remains in the subgrade and freezes, frost heaves and ice lenses may form, potentially causing severe pavement movement and cracking.

### Entryways and Sidewalks

Exterior concrete slabs, such as those at entryways and sidewalks adjacent to the building should be designed to mitigate differential frost movement between adjacent slabs, doorways, and pavements. To address this concern, we recommend that concrete slabs at entryways be underlain by four feet of non-frost susceptible Sand and Gravel fill. Where exterior slabs butt against hard surfaces, we recommend that for the area beyond the edges of the slab, the bottom of Sand and Gravel fill should transition gradually upward at a slope of 3H:1V or flatter (zone of influence).

We recommend that concrete sidewalks that are outside the zone of influence of the building and entryways, as well as areas where differential frost movement would not cause a tripping hazard, bear on at least 12 inches of imported, compacted Sand and Gravel to provide uniform support and a capillary moisture break. Fill should be placed in accordance with the recommendations for compaction provided on Sheet 1. Subgrades should also be free of large boulders. We recommend that the entire subgrade of the sidewalk be proof compacted with a heavy vibrating roller to treat any loose areas. In addition, we recommend that the design team incorporate drainage into the sidewalk areas to remove water from the subgrade, in order to limit frost and the resulting vertical movement of sidewalks. The Sand and Gravel fill beneath the concrete slabs and sidewalks should meet the grain size distribution characteristics described in Table 2.

### Pavement Subgrade Recommendations

We understand that the proposed project will involve the construction of parking areas and roadways for both light vehicles and heavy vehicles and may include both flexible and rigid pavements. We recommend that the pavement subgrade be proof compacted to treat any loose areas present. We note that the near-surface silty soils present at the Site are poorly drained, are susceptible to disturbances during construction, and have the potential to cause frost heaves to occur in pavements. We recommend that pavements be pitched to promote surface water runoff. In addition, subsurface drainage should be provided to prevent water from accumulating on the surface during construction, and beneath pavement sections after installation.

### Preliminary Earthwork Considerations

Final Site grading and building slab elevations are unknown at this time. However, we anticipate that earthwork for this project will include the following: excavations for footings, infiltration basins, roadways and parking areas, and utilities; cuts and fills to achieve Site grades and prepare the building pad and pavement base course; and the treatment of the



existing soils to address any localized loose areas that may be present. No bedrock was encountered during our investigations; however, the bedrock surface may vary locally. Therefore, bedrock may be encountered if significant cuts or proposed and/or the structure locations changes from areas explored during these investigations.

Four engineered fill types are recommended:

- Sand and Gravel for use immediately below footings, slabs, and beneath sidewalks;
- Crushed Stone in drainage systems (as needed);
- Gravel Base Course for use beneath pavements; and
- Granular Fill for use as miscellaneous fill and to form the building pads at depths greater than 12 inches beneath floor slabs and footings.

Grain size distribution requirements are presented in Table 2. On-Site soils may be suitable for re-use as Granular Fill, if free from deleterious and/or oversized material. If silty pockets of materials are encountered, these soils may not be suitable for reuse as fill due to its susceptibility to disturbance when exposed to moisture. If the contractor elects to use the on-Site material as fill, we recommend that a representative sample be collected and a grain size distribution analysis is performed to obtain approval by the engineer. Please note that the Sand and Gravel specification is approximately that for Mass Highway M1.03.0, Type B Gravel Borrow.

**Table 2**  
**Grain Size Distribution Requirements**

Size	Sand and Gravel	Gravel Base Course	Granular Fill	Crushed Stone
	Percent Finer by Weight			
3	100	100	100	---
1 ½ inch	---	70-100	---	---
1 inch	---	---	---	100
¾ inch	---	50-85	---	90-100
½ inch	50-85	---	---	10-50
⅜ inch	---	---	---	0-20
No. 4	40-75	30-60	---	0-5
No. 10	---	---	30-90	---
No. 40	10-35	---	10-70	---
No. 200	0-10	0-10	0-15	---

**Compaction Recommendations**

Fill, debris, topsoil, and organic soils should be removed from beneath the building footprint and should not be re-used as fill beneath structures. To avoid point loads, any cobbles or boulders larger than four inches in diameter, encountered at the subgrade should also be removed. The resulting excavations should be backfilled with compacted Sand and Gravel or Crushed Stone fill.

Prior to the placement of any engineered fill, we recommend that the entire building footprint be thoroughly proof compacted. Proof compaction should be accomplished by a minimum of six passes with a 6,000 pound vibratory roller. To facilitate compaction, the moisture content of the on-Site material should be maintained at or near the optimum moisture content as determined by ASTM D1557.

Compacted fill should be placed in lifts ranging in thickness between 6 and 12 inches depending on the size and type of equipment. Recommended degrees of compaction and compaction means and methods are presented on Sheet 1.

Compaction within five feet of foundation or retaining walls should be performed using a hand-operated roller or vibratory plate compactor. If the new walls are to be backfilled on both sides, placement and compaction of engineered fill should proceed on both sides of the wall so that the difference in top of fill on either side does not exceed two feet. For basement or retaining walls (walls where backfill is only on one side), the walls should be designed for unbalanced loading conditions and the engineered fill within ten feet of the wall should be compacted using hand-operated plate or drum rollers weighing 250 pounds or less.

#### Weather Considerations

The contractor should note that the near surface silty soils underlying glacial till present at the Site is susceptible to moisture, due to the high percentage of fines within the soil mass. If these soils are exposed and become wet during construction, they will become soft and easily disturbed. During winter construction periods, these fine grained soils will tend to remain wet and cannot be easily dried or stabilized. It may be necessary to remove the disturbed soils and replace the materials with Crushed Stone. To avoid this potential issue, the contractor should establish and maintain proper drainage of soil surfaces.

#### **DESIGN PHASE INVESTIGATIONS AND TESTING**

This preliminary study indicates that conditions are favorable for the project. We note that design phase explorations will be required. The number and scope of additional explorations will depend upon the final location and footprint of any new building and the depth of utilities and below grade structures. Typically, design phase borings should be completed at a spacing of 100 feet, or less.

We appreciated the opportunity to be of service on this project. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely yours,  
O'Reilly, Talbot & Okun Associates, Inc.



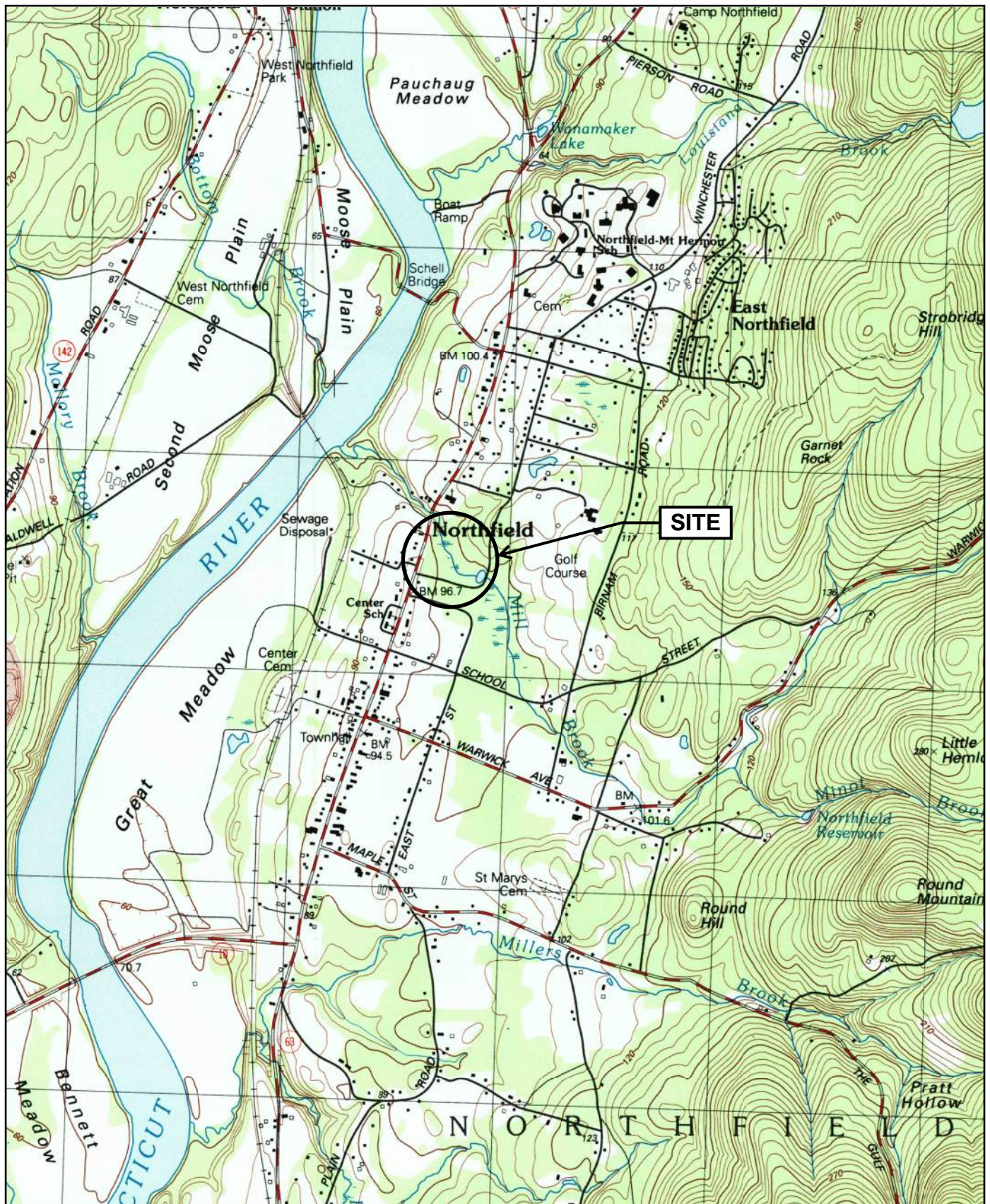
Ashley L. Sullivan, P.E.  
Principal

Attachments: Limitations, Site Locus, Site Figure, Boring Logs, Test Pit Logs, Test Pit Photographs, Laboratory Data Sheets

## LIMITATIONS

1. The observations presented in this report were made under the conditions described herein. The conclusions presented in this report were based solely upon the services described in the report and not on scientific tasks or procedures beyond the scope of the project or the time and budgetary constraints imposed by the client. The work described in this report was carried out in accordance with the Statement of Terms and Conditions attached to our proposal.
2. The analysis and recommendations submitted in this report are based in part upon the data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it may be necessary to reevaluate the recommendations of this report.
3. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.
4. In the event that any changes in the nature, design or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by O'Reilly, Talbot & Okun Associates Inc. It is recommended that we be retained to provide a general review of final plans and specifications.
5. Our report was prepared for the exclusive benefit of our client. Reliance upon the report and its conclusions is not made to third parties or future property owners.





0 1000 0 0.5 1.0 0 0.5 1  
FEET MILES KILOMETERS

1:25,000 SCALE NATIONAL GEODETIC VERTICAL DATUM 1929 10 FOOT CONTOUR INTERVAL

## EMERGENCY SERVICES BUILDING

MAIN STREET  
NORTHFIELD, MASSACHUSETTS

## SITE LOCUS

Topographic Map Quadrant:  
NORTHFIELD, MA

Map Version: 1990

Current As Of: 2002

Date: MAY 2022

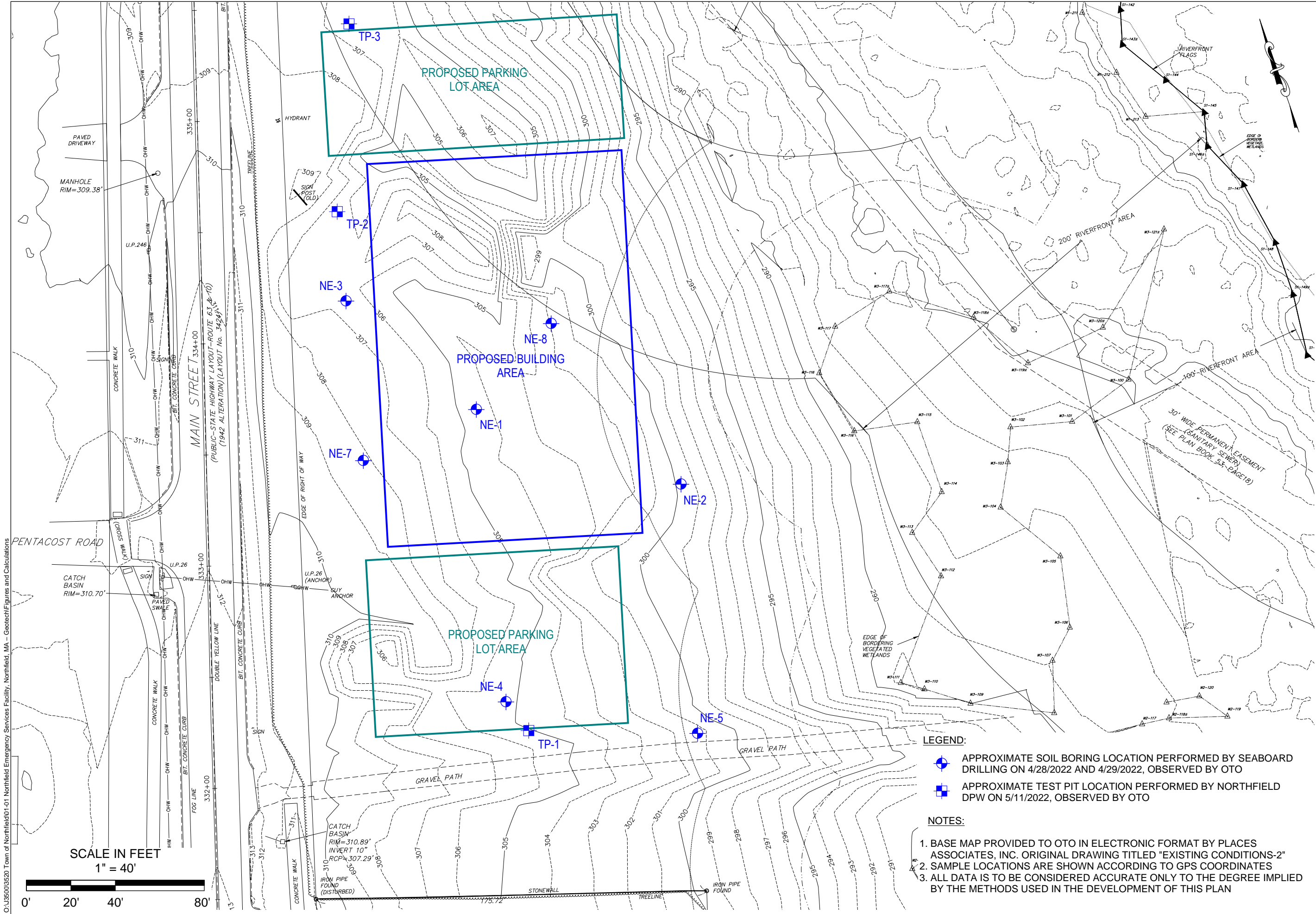
PROJECT No.

**J3520-01-01**

FIGURE No.

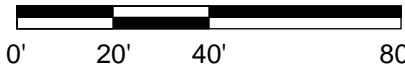
**1**





O:\J3520\J3520 Town of Northfield\01-01 Northfield Emergency Services Facility, Northfield, MA - Geotech\Figures and Calculations

SCALE IN FEET  
1" = 40'



LEGEND:

- APPROXIMATE SOIL BORING LOCATION PERFORMED BY SEABOARD DRILLING ON 4/28/2022 AND 4/29/2022, OBSERVED BY OTO
- APPROXIMATE TEST PIT LOCATION PERFORMED BY NORTHFIELD DPW ON 5/11/2022, OBSERVED BY OTO

NOTES:

1. BASE MAP PROVIDED TO OTO IN ELECTRONIC FORMAT BY PLACES ASSOCIATES, INC. ORIGINAL DRAWING TITLED "EXISTING CONDITIONS-2"
2. SAMPLE LOCATIONS ARE SHOWN ACCORDING TO GPS COORDINATES
3. ALL DATA IS TO BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHODS USED IN THE DEVELOPMENT OF THIS PLAN

DESIGNED BY: SLR  
DRAWN BY: SLR  
CHECKED BY: DAH  
DATE: 05/18/2022  
REV. DATE: 05/18/2022

EMERGENCY SERVICES BUILDING

MAIN STREET  
NORTHFIELD, MASSACHUSETTS

SITE PLAN

PROJECT NO.  
J3520-01-01  
FIGURE NO.

## **BORING LOGS**

### **SUMMARY OF THE BURMISTER SOIL CLASSIFICATION SYSTEM (MODIFIED)**

#### **RELATIVE DENSITY (of non-plastic soils) OR CONSISTENCY (of plastic soils)**

STANDARD PENETRATION TEST (SPT)		COHESIONLESS SOILS		COHESIVE SOILS	
Method: Samples were collected in accordance with ASTM D1586, using a 2" diameter split spoon sampler driven 24 inches. If samples were collected using direct push methodology (Geoprobe), SPTs were not performed and relative density/consistency were not reported. N-Value: The number of blows with a 140 lb. hammer required to drive the sampler the middle 12 inches. WOR: Weight Of Rod (depth dependent) WOH: Weight Of Hammer (140 lbs.)		BLOWS/FOOT (SPT N-Value)	RELATIVE DENSITY	BLOWS/FOOT (SPT N-Value)	CONSISTENCY
		0-4	Very loose	<2	Very soft
		4-10	Loose	2-4	Soft
		10-30	Medium dense	4-8	Medium Stiff
		30-50	Dense	8-15	Stiff
		>50	Very dense	15-30	Very stiff
		*Based upon uncorrected field N-values		>30	Hard

#### **MATERIAL: (major constituent identified in CAPITAL letters)**

COHESIONLESS SOILS		
MATERIAL	FRACTION	GRAIN SIZE RANGE
GRAVEL	Coarse	3/4" to 3"
	Fine	1/4" to 3/4"
SAND	Coarse	1/16" to 1/4"
	Medium	1/64" to 1/16"
	Fine	Finest visible & distinguishable particles
SILT/CLAY	see adjacent table	Cannot distinguish individual particles
COBBLES	3" to 6" in diameter	
BOULDERS	> 6" in diameter	
Note: Boulders and cobbles are observed in test pits and/or auger cuttings.		

COHESIVE SOILS		
SMALLEST DIAMETER	PLASTICITY	IDENTITY
None	Non-plastic	SILT
1/4" (pencil)	Slight	Clayey SILT
1/8"	Low	SILT & CLAY
1/16"	Medium	CLAY & SILT
1/32"	High	Silty CLAY
1/64"	Very High	CLAY
Wetted sample is rolled in hands to smallest possible diameter before breaking.		

Note: Boulders and cobbles are observed in test pits and/or auger cuttings.

**ORGANIC SILT:** Typically gray to dark gray, often has strong H<sub>2</sub>S odor. May contain shells or shell fragments. Light weight.

Fibrous PEAT: Light weight, spongy, mostly visible organic matter, water squeezed readily from sample. Typically near top of layer.

Fine grained PEAT: Light weight, spongy, little visible organic matter, water squeezed from sample. Typically below fibrous peat.

**DEBRIS:** Detailed contents described in parentheses (wood, glass, ash, crushed brick, metal, etc.)

**BEDROCK:** Underlying rock beneath loose soil, can be weathered (easily crushed) or competent (difficult to crush).

#### **ADDITIONAL CONSTITUENTS**

TERM	% OF TOTAL
and	35-50%
some	20-35%
little	10-20%
trace	1-10%

#### **COMMON TERMS**

Glacial till: Very dense/hard, heterogeneous mixture of sand, silt, clay, sub-angular gravel. Deposited at base of glaciers, which covered all of New England.

Varved clay: Fine-grained, post-glacial lake sediments characterized by alternating layers (or varves) of silt, sand and clay.

Fill: Material used to raise ground, can be engineered or non-engineered.

#### **COMMON FIELD MEASUREMENTS**

Torvane: Undrained shear strength is estimated using an E285 Pocket Torvane (TV). Values in tons/ft<sup>2</sup>.

Penetrometer: Unconfined compressive strength is estimated using a Pocket Penetrometer (PP). Values in tons/ft<sup>2</sup>.

RQD: Rock Quality Designation is determined by measuring total length of pieces of core 4" or greater and dividing by the total length of the run, expressed as %. 100-90% excellent; 90-75% good; 75-50% fair; 50-25% poor; 25-0% very poor.

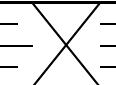
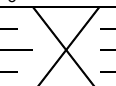
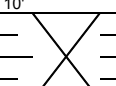
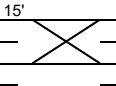
PID: Soil screened for volatile organic compounds (VOCs) using a photoionization detector (PID) referenced to benzene in air. Readings in parts per million by volume.



**LOG OF BORING NE-1**

Page 1 of 1

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Seaboard Environmental Drilling		
JOB NUMBER	3520-01-01	FINAL DEPTH (ft)	15.8	DRILLING EQUIPMENT	D-50 Track Mounted Rig		
LOCATION	Northfield, MA	SURFACE ELEV (ft)	304.5	FOREMAN	Dale	CASING	
START DATE	4/28/2022	DISTURBED SAMPLES	4	HELPER	Mike	CASE DIAMETER	N/A
FINISH DATE	4/28/2022	UNDISTURBED SAMPLES	0	BIT TYPE	Hollow Stem Auger	HAMMER WGT	N/A
ENGINEER/SCIENTIST	Caren Irgang		WATER LEVEL	ROD TYPE	A (1 5/8" O.D.)	HAMMER DROP	N/A
BORING LOCATION	Approximate center of proposed building area	FIRST (ft)	5.0	SAMPLER	2" O.D. Split Spoon	ROCK CORING INFORMATION	
		LAST (ft)	5.0	HAMMER TYPE	Automatic	TYPE	N/A
		TIME (hr)	24.00	HAMMER WGT/DROP	140 lb / 30"	SIZE	N/A

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS/ WELL CONSTRUCTION
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.	
	1/2/2/6	8/24	S-1 (0-2')	0.0	Top 3" : Loose, dark brown, fine SAND and SILT, trace organics (roots, leaves), damp (FOREST DUFF) Bottom 5": Loose, dark brown to brown, fine to medium SAND, little silt, trace gravel, damp	FOREST DUFF		1.
						FINE TO MEDIUM SAND		
	6/10/11/14	16/24	S-2 (5-7')	0.0	Top 5": Medium dense, brown, medium to coarse SAND, little silt, moist Next 1": Medium dense, brown, GRAVEL, moist (fractured rock) Bottom 10": Medium dense, brown, fine SAND, trace medium to coarse sand, trace fine gravel, wet	▽ =	299.5	
						8.0	296.5	2.
	19/24/25/26	23/24	S-3 (10-12')	0.0	Dense, brown, fine to medium SAND, trace fine to coarse sand, little fine gravel, wet (some rust staining ; GLACIAL TILL)	GLACIAL TILL		
	21/50 for 4"	10/10	S-4 (15-15.8')	0.0	Top 6": Very dense, brown, SILT and fine SAND, some fine gravel, trace medium sand, wet (GLACIAL TILL) Bottom 4": Very dense, brown gray, SILT and fine SAND, little coarse sand, wet (some rust staining; GLACIAL TILL)			3.
					End of Exploration at 15.8'	15.8	288.7	

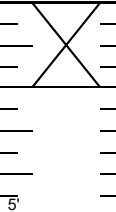
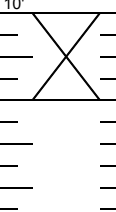
Remarks: 1. Soil screened in field using MiniRAE Lite photoionization detector (PID) referenced to benzene in air. Readings in parts per million (PPM) by volume. 2. Difficult drilling conditions between 8 and 15 feet below ground surface. 3. Boring was left open overnight to determine groundwater level.	<b>PROJECT NO.</b> <b>3520-01-01</b>
	<b>LOG OF BORING</b> <b>NE-1</b>



**LOG OF BORING NE-3**

Page 1 of 1

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Seaboard Environmental Drilling		
JOB NUMBER	3520-01-01	FINAL DEPTH (ft)	12.0	DRILLING EQUIPMENT	D-50 Track Mounted Rig		
LOCATION	Northfield, MA	SURFACE ELEV (ft)	306.5	FOREMAN	Dale	CASING	
START DATE	4/29/2022	DISTURBED SAMPLES	3	HELPER	Mike	CASE DIAMETER	N/A
FINISH DATE	4/29/2022	UNDISTURBED SAMPLES	0	BIT TYPE	Hollow Stem Auger	HAMMER WGT	N/A
ENGINEER/SCIENTIST	Caren Irgang		WATER LEVEL	ROD TYPE	A (1 5/8" O.D.)	HAMMER DROP	N/A
BORING LOCATION	Approximate northwest corner of proposed building area	FIRST (ft)	N/E	SAMPLER	2" O.D. Split Spoon	ROCK CORING INFORMATION	
		LAST (ft)	N/E	HAMMER TYPE	Automatic	TYPE	N/A
		TIME (hr)	3.00	HAMMER WGT/DROP	140 lb / 30"	SIZE	N/A

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS/ WELL CONSTRUCTION
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.	
	1/1/1/2	16/24	S-1 (0-2')	0.0	Top 4": Very loose, very dark brown, fine SAND, some silt, trace organics (roots, leaves), damp (FOREST DUFF) Next 8": Very loose, dark brown, fine SAND, trace silt, trace organics (roots, leaves), damp (TOPSOIL) Bottom 4": Very loose, brown, medium SAND, trace silt, trace organics (roots), damp	FOREST DUFF TOPSOIL 1.5 ↓ 305.0 FINE TO MEDIUM SAND		1.
	12/14/9/18	17/24	S-2 (5-7')	0.0	Medium dense, red brown, fine SAND, some silt, little coarse sand, trace gravel, damp	8.0 ↓ 298.5 GLACIAL TILL		2.
	23/25/24/29	17/24	S-3 (10-12')	0.1	Dense, brown, fine SAND, some silt, little coarse sand, little gravel, damp (GLACIAL TILL)	12.0 ↓ 294.5		3.
End of Exploration at 12'								

Remarks:

- Soil screened in field using MiniRAE Lite photoionization detector (PID) referenced to benzene in air. Readings in parts per million (PPM) by volume.
- Difficult drilling conditions between 8 and 12 feet below ground surface.
- Boring was left open overnight to determine groundwater level.

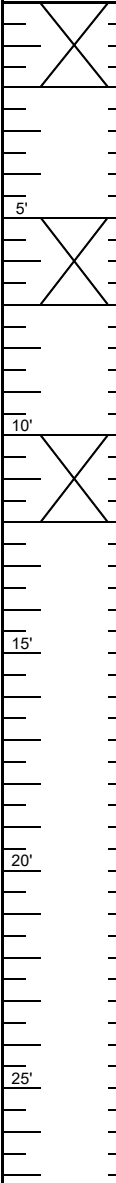
**PROJECT NO.**  
**3520-01-01**

**LOG OF BORING**  
**NE-3**

**LOG OF BORING NE-4**

Page 1 of 1

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Seaboard Environmental Drilling		
JOB NUMBER	3520-01-01	FINAL DEPTH (ft)	12.0	DRILLING EQUIPMENT	D-50 Track Mounted Rig		
LOCATION	Northfield, MA	SURFACE ELEV (ft)	305.0	FOREMAN	Dale	CASING	
START DATE	4/28/2022	DISTURBED SAMPLES	3	HELPER	Mike	CASE DIAMETER	N/A
FINISH DATE	4/28/2022	UNDISTURBED SAMPLES	0	BIT TYPE	Hollow Stem Auger	HAMMER WGT	N/A
ENGINEER/SCIENTIST	Caren Irgang		WATER LEVEL	ROD TYPE	A (1 5/8" O.D.)	HAMMER DROP	N/A
BORING LOCATION	Approximate center of proposed south parking area	FIRST (ft)	6.0	SAMPLER	2" O.D. Split Spoon	ROCK CORING INFORMATION	
		LAST (ft)	4.5	HAMMER TYPE	Automatic	TYPE	N/A
		TIME (hr)	24.00	HAMMER WGT/DROP	140 lb / 30"	SIZE	N/A

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS/ WELL CONSTRUCTION
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.	
	1/1/1 for 12"	11/24	S-1 (0-2')	0.0	Top 4": Very soft, very dark brown, SILT, some fine sand, trace organics (roots, leaves), damp (FOREST DUFF) Bottom 7": Very loose, brown to dark brown, fine to medium SAND, some silt, damp (TOPSOIL)	FOREST DUFF TOPSOIL FINE TO MEDIUM SAND		1.
	6/6/6/8	23/24	S-2 (5-7')	0.0	Top 11": Medium dense, brown, fine to medium SAND, trace coarse sand, trace silt, damp (bottom 2" wet, slight rust staining) Next 4": Stiff, brown, varved SILT and CLAY, wet Bottom 8": Medium dense, brown, fine to medium SAND, trace coarse sand, trace gravel, wet	▽ =	299.0	
	11/13/20/27	24/24	S-3 (10-12')	0.0	Dense, brown, fine SAND and SILT, little coarse sand, trace medium sand, wet (GLACIAL TILL)	10.0 ↓ 12.0	295.0 293.0	2.
End of Exploration at 12'								

Remarks:

1. Soil screened in field using MiniRAE Lite photoionization detector (PID) referenced to benzene in air. Readings in parts per million (PPM) by volume.
2. Boring was left open overnight to determine groundwater level.

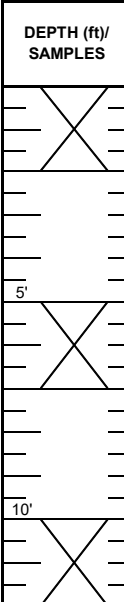
**PROJECT NO.**  
**3520-01-01**

**LOG OF BORING**  
**NE-4**

**LOG OF BORING NE-5**

Page 1 of 1

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Seaboard Environmental Drilling		
JOB NUMBER	3520-01-01	FINAL DEPTH (ft)	12.0	DRILLING EQUIPMENT	D-50 Track Mounted Rig		
LOCATION	Northfield, MA	SURFACE ELEV (ft)	301.0	FOREMAN	Dale	CASING	
START DATE	4/28/2022	DISTURBED SAMPLES	3	HELPER	Mike	CASE DIAMETER	N/A
FINISH DATE	4/28/2022	UNDISTURBED SAMPLES	0	BIT TYPE	Hollow Stem Auger	HAMMER WGT	N/A
ENGINEER/SCIENTIST	Caren Irgang		WATER LEVEL	ROD TYPE	A (1 5/8" O.D.)	HAMMER DROP	N/A
BORING LOCATION	Southeast portion of site	FIRST (ft)	3.0	SAMPLER	2" O.D. Split Spoon	ROCK CORING INFORMATION	
		LAST (ft)	N/A	HAMMER TYPE	Automatic	TYPE	N/A
		TIME (hr)	N/A	HAMMER WGT/DROP	140 lb / 30"	SIZE	N/A

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS/ WELL CONSTRUCTION
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.	
	1/2/2/3	11/24	S-1 (0-2')	0.0	Top 4": Loose, very dark brown, SILT and fine SAND, trace coarse sand, trace organics (roots, leaves), damp (FOREST DUFF) Next 6": Loose, dark brown, fine SAND and SILT, trace organics (sticks), trace fine gravel, damp (FOREST DUFF) Bottom 1": Loose, brown, fine to medium SAND, some silt, trace coarse sand, damp	FOREST DUFF TOPSOIL FINE TO MEDIUM SAND	298.0	1.
	9/7/5/11	18/24	S-2 (5-7')	0.0	Medium dense, gray to brown, fine SAND, trace medium to coarse sand, trace fine gravel, moist (some rust staining)			
	37/43/39/30	9/24	S-3 (10-12')	0.0	Very dense, light gray to brown, SILT and fine SAND, trace coarse sand, trace gravel, moist (fractured rock at 5" from top; GLACIAL TILL)	GLACIAL TILL	291.0	
					End of Exploration at 12'	12.0	289.0	

Remarks:

1. Soil screened in field using MiniRAE Lite photoionization detector (PID) referenced to benzene in air. Readings in parts per million (PPM) by volume.

**PROJECT NO.**  
**3520-01-01**

**LOG OF BORING**  
**NE-5**

**LOG OF BORING NE-7**

Page 1 of 1

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Seaboard Environmental Drilling		
JOB NUMBER	3520-01-01	FINAL DEPTH (ft)	17.0	DRILLING EQUIPMENT	D-50 Track Mounted Rig		
LOCATION	Northfield, MA	SURFACE ELEV (ft)	308.0	FOREMAN	Dale	CASING	
START DATE	4/29/2022	DISTURBED SAMPLES	5	HELPER	Mike	CASE DIAMETER	N/A
FINISH DATE	4/29/2022	UNDISTURBED SAMPLES	0	BIT TYPE	Hollow Stem Auger	HAMMER WGT	N/A
ENGINEER/SCIENTIST	Caren Irgang		WATER LEVEL	ROD TYPE	A (1 5/8" O.D.)	HAMMER DROP	N/A
BORING LOCATION	Approximate southwest corner of proposed building area	FIRST (ft)	7.0	SAMPLER	2" O.D. Split Spoon	ROCK CORING INFORMATION	
		LAST (ft)	N/A	HAMMER TYPE	Automatic	TYPE	N/A
		TIME (hr)	N/A	HAMMER WGT/DROP	140 lb / 30"	SIZE	N/A

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS/ WELL CONSTRUCTION
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.	
	1/1/1/1	12/24	S-1 (0-2')	0.0	Top 3": Very loose, very dark brown, fine SAND, some silt, trace organics (roots, leaves), damp (FOREST DUFF) Bottom 9": Very loose, brown, fine SAND, some silt, trace medium sand, trace organics (roots, leaves), damp (TOPSOIL)	FOREST DUFF		1.
						TOPSOIL		
	22/12/11/8	14/24	S-2 (5-7')	0.0	Top 4": Medium dense, brown, fine to medium SAND, little coarse sand, trace silt, damp Next 1": Medium dense, light gray, GRAVEL, damp Next 6": Medium dense, brown, medium to coarse SAND, some fine sand, trace silt, damp Bottom 3": Medium dense, brown, fine to medium SAND, trace silt, moist		301.0	
	12/12/14/16	24/24	S-3 (10-12')	0.0	Medium dense, brown, fine SAND and SILT, little fine gravel, trace coarse gravel, damp (trace rust staining; GLACIAL TILL)		298.0	
	20/17/13/16	15/24	S-4 (12-14')	0.0	Dense, brown, fine SAND and SILT, little to trace gravel, damp (trace rust staining; GLACIAL TILL)			
	10/17/21/29	18/24	S-5 (15-17')	0.1	Dense, brown, fine SAND and SILT, little to trace gravel, (trace rust staining; GLACIAL TILL)		291.0	
End of Exploration at 17'						17.0		

Remarks:

1. Soil screened in field using MiniRAE Lite photoionization detector (PID) referenced to benzene in air. Readings in parts per million (PPM) by volume.

**PROJECT NO.**  
**3520-01-01**

**LOG OF BORING**  
**NE-7**



**LOG OF BORING NE-8**

Page 1 of 1

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Seaboard Environmental Drilling		
JOB NUMBER	3520-01-01	FINAL DEPTH (ft)	12.0	DRILLING EQUIPMENT	D-50 Track Mounted Rig		
LOCATION	Northfield, MA	SURFACE ELEV (ft)	302.0	FOREMAN	Dale	CASING	
START DATE	4/29/2022	DISTURBED SAMPLES	3	HELPER	Mike	CASE DIAMETER	N/A
FINISH DATE	4/29/2022	UNDISTURBED SAMPLES	0	BIT TYPE	Hollow Stem Auger	HAMMER WGT	N/A
ENGINEER/SCIENTIST	Caren Irgang		WATER LEVEL	ROD TYPE	A (1 5/8" O.D.)	HAMMER DROP	N/A
BORING LOCATION	Approximate northeast corner of proposed building area	FIRST (ft)	3.0	SAMPLER	2" O.D. Split Spoon	ROCK CORING INFORMATION	
		LAST (ft)	N/A	HAMMER TYPE	Automatic	TYPE	N/A
		TIME (hr)	N/A	HAMMER WGT/DROP	140 lb / 30"	SIZE	N/A

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS/ WELL CONSTRUCTION
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.	
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Remarks:

1. Soil screened in field using MiniRAE Lite photoionization detector (PID) referenced to benzene in air. Readings in parts per million (PPM) by volume.

**PROJECT NO.**  
**3520-01-01**

**LOG OF BORING**  
**NE-8**

**LOG OF TEST PIT TP-1**

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Northfield DPW
JOB NO.	3520-01-01	DATE	05/11/2022	OPERATOR	Josh
LOCATION	Northfield, MA.	WEATHER	Sunny, 60°F	BACKHOE	Takeuchi TD153
TEST PIT LOCATION	Within proposed southern parking lot area	START TIME	0800	CAPACITY (cy)	0.5 yd <sup>3</sup>
		FINISH TIME	0900	GS ELEV. (ft)	305.0
		OTO STAFF	Jhonatan Escobar	FINAL DEPTH (ft)	7.0

DEPTH (ft)	SOIL DESCRIPTION	EXCAV. EFFORT	BOULDERS/ COBBLES COUNT	CLASS	SAMPLE NO.	FIELD TEST DATA	REMARKS
1'	1" FOREST DUFF 9": Dark brown, fine SAND, little silt, trace medium sand, trace organics (roots), damp (TOPSOIL)	E	--	--			
2'	Brown to light brown, fine to medium SAND, little to trace silt, trace organics (roots), damp	E	--	--			
4'	Brown, fine to medium SAND, trace (+) silt, trace organics (roots), moist	E	--	--			2
5.5'	Groundwater entering test pit at 5.5'						1
6'	Gray with slight rust staining, clayey SILT, trace fine sand, trace organics (roots), wet	E	--	--			
7'	End of Exploration at 7'						
8'							
9'							
10'							
11'							

TEST PIT PLAN	EXCAVATION EFFORT	BOULDER/COBBLE CLASS	PROPORTIONS USED	GROUNDWATER CONDITIONS																									
<div><div>3'</div><div>6'</div><div>N</div></div>	<div>Easy .....E</div> <div>Moderate .....M</div> <div>Difficult .....D</div> <div>Very Difficult .....V</div>	<table><thead><tr><th>Type</th><th>Size</th><th>Abbr.</th></tr></thead><tbody><tr><td>Cobble</td><td>3" - 6"</td><td>C</td></tr><tr><td>Small</td><td>6" - 18"</td><td>S</td></tr><tr><td>Medium</td><td>18" - 36"</td><td>M</td></tr><tr><td>Large</td><td>36" and Larger</td><td>L</td></tr></tbody></table>	Type	Size	Abbr.	Cobble	3" - 6"	C	Small	6" - 18"	S	Medium	18" - 36"	M	Large	36" and Larger	L	<table><thead><tr><th>Term</th><th>Relative Quantity</th></tr></thead><tbody><tr><td>and</td><td>35% - 50%</td></tr><tr><td>some</td><td>20% - 35%</td></tr><tr><td>little</td><td>10% - 20%</td></tr><tr><td>trace</td><td>10% or less</td></tr></tbody></table>	Term	Relative Quantity	and	35% - 50%	some	20% - 35%	little	10% - 20%	trace	10% or less	<div>GW Encountered?: Yes</div> <div>GW Depth (ft): 5.5</div> <div>GW Elevation (ft): 299.5</div> <div>Elapsed Time (min): N/A</div>
Type	Size	Abbr.																											
Cobble	3" - 6"	C																											
Small	6" - 18"	S																											
Medium	18" - 36"	M																											
Large	36" and Larger	L																											
Term	Relative Quantity																												
and	35% - 50%																												
some	20% - 35%																												
little	10% - 20%																												
trace	10% or less																												

<b>Remarks:</b> 1. Seasonal High Groundwater estimated at 5' 2. Infiltration test performed adjacent to test pit at 4' below ground surface	<b>PROJECT NO.</b>
	<b>3520-01-01</b>
	<b>LOG OF TEST PIT</b> <b>TP-1</b>

**LOG OF TEST PIT TP-2**

PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Northfield DPW
JOB NO.	3520-01-01	DATE	05/11/2022	OPERATOR	Josh
LOCATION	Northfield, MA.	WEATHER	Sunny, 60°F	BACKHOE	Takeuchi TD153
TEST PIT LOCATION	Within proposed northern parking lot area	START TIME	09:30	CAPACITY (cy)	0.5
		FINISH TIME	10:15	GS ELEV. (ft)	307.0
		OTO STAFF	Jhonatan Escobar	FINAL DEPTH (ft)	8.0

DEPTH (ft)	SOIL DESCRIPTION	EXCAV. EFFORT	BOULDERS/ COBBLES COUNT	CLASS	SAMPLE NO.	FIELD TEST DATA	REMARKS
1'	Dark brown, fine SAND, little silt, trace medium sand, trace organics (roots), damp (TOPSOIL)	E	--	--			
2'							
3'							
4'	Light brown, fine to medium SAND, trace gravel, trace silt, trace coarse sand, damp	M	10 20 1	C S M			2
5'	Numerous cobbles and boulders from 3 to 6.5 feet						
6'							
7'							
8'	End of Exploration at 8'						
9'							
10'							
11'							

TEST PIT PLAN	EXCAVATION EFFORT	BOULDER/COBBLE CLASS	PROPORTIONS USED	GROUNDWATER CONDITIONS																									
<div><div>3'</div><div>6'</div><div>N</div></div>	<div>Easy .....E</div> <div>Moderate .....M</div> <div>Difficult .....D</div> <div>Very Difficult .....V</div>	<table><tr><th>Type</th><th>Size</th><th>Abbr.</th></tr><tr><td>Cobble</td><td>3" - 6"</td><td>C</td></tr><tr><td>Small</td><td>6" - 18"</td><td>S</td></tr><tr><td>Medium</td><td>18" - 36"</td><td>M</td></tr><tr><td>Large</td><td>36" and Larger</td><td>L</td></tr></table>	Type	Size	Abbr.	Cobble	3" - 6"	C	Small	6" - 18"	S	Medium	18" - 36"	M	Large	36" and Larger	L	<table><tr><th>Term</th><th>Relative Quantity</th></tr><tr><td>and</td><td>35% - 50%</td></tr><tr><td>some</td><td>20% - 35%</td></tr><tr><td>little</td><td>10% - 20%</td></tr><tr><td>trace</td><td>10% or less</td></tr></table>	Term	Relative Quantity	and	35% - 50%	some	20% - 35%	little	10% - 20%	trace	10% or less	<div>GW Encountered?: No</div> <div>GW Depth (ft): N/A</div> <div>GW Elevation (ft): N/A</div> <div>Elapsed Time (min): N/A</div>
Type	Size	Abbr.																											
Cobble	3" - 6"	C																											
Small	6" - 18"	S																											
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Large	36" and Larger	L																											
Term	Relative Quantity																												
and	35% - 50%																												
some	20% - 35%																												
little	10% - 20%																												
trace	10% or less																												

<b>Remarks:</b> 1. No indications of Seasonal High Groundwater Observed 2. Infiltration test performed adjacent to test pit at 3' below ground surface	<b>PROJECT NO.</b>  <b>3520-01-01</b>
	<b>LOG OF TEST PIT</b>  <b><u>TP-2</u></b>





**Photograph 1 : TP-1**



**Photograph 2 : TP-1**



**Photograph 3 : TP-1**



**Photograph 4 : TP-2**





**Photograph 5 : TP-2**



**Photograph 6 : TP-2**



**Photograph 7 : TP-3**



**Photograph 8 : TP-3**





**Photograph 9 : TP-3**





### LOG OF TEST PIT TP-3

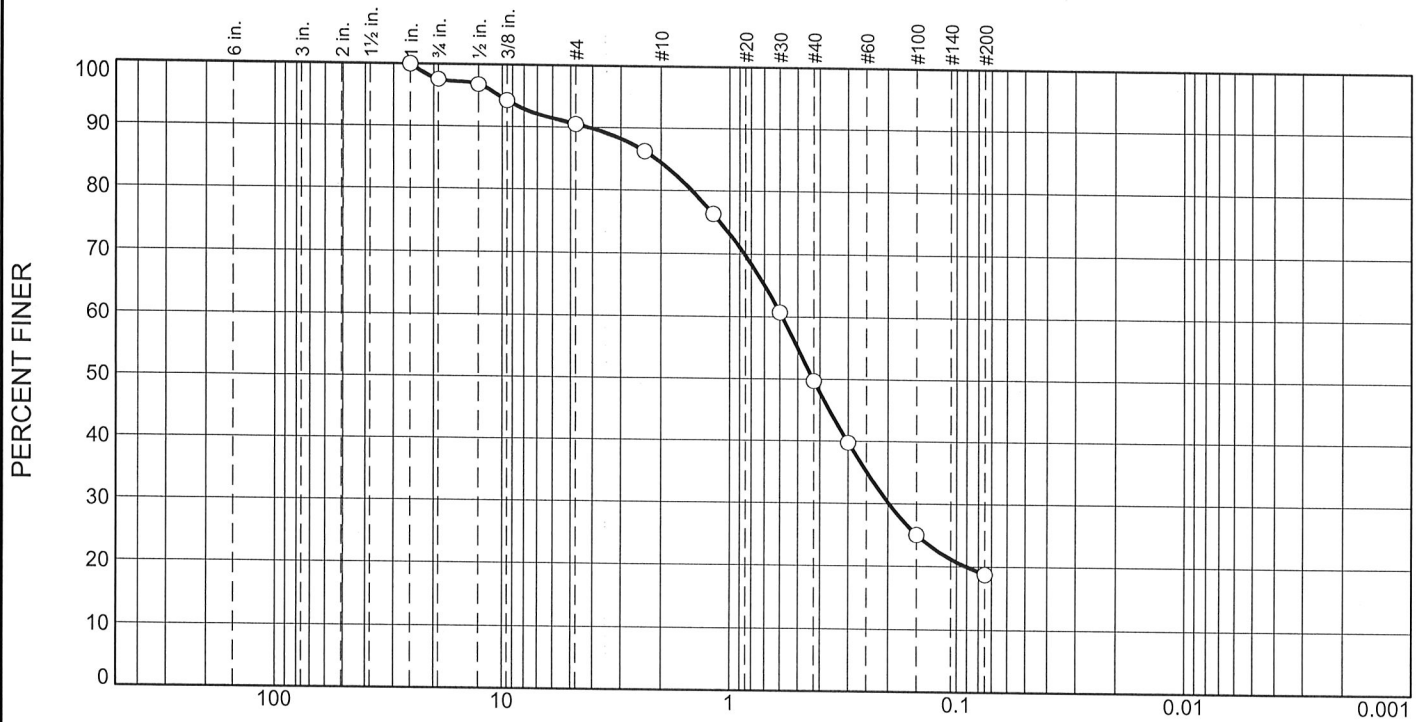
PROJECT	Northfield Emergency Services Facility Project			CONTRACTOR	Northfield DPW
JOB NO.	3520-01-01	DATE	05/11/2022	OPERATOR	Josh
LOCATION	Northfield, MA.	WEATHER	Sunny, 60°F	BACKHOE	Takeuchi TD153
TEST PIT LOCATION	North of proposed northern parking lot area	START TIME	10:30	CAPACITY (cy)	0.5
		FINISH TIME	11:30	GS ELEV. (ft)	307.0
		OTO STAFF	Jhonatan Escobar	FINAL DEPTH (ft)	9.0

DEPTH (ft)	SOIL DESCRIPTION	EXCAV. EFFORT	BOULDERS/ COBBLES COUNT	CLASS	SAMPLE NO.	FIELD TEST DATA	REMARKS
1'	Dark brown, fine SAND, little silt, trace medium sand, trace organics (roots), damp (TOPSOIL)	E	--	--			
2'							
3'							
4'	Brown, fine to medium SAND, trace (+) silt, trace gravel, trace organics (roots), trace debris (brick) at 3', damp (FILL)	M	10 5	C S			2
5'							
6'							
7'							
8'							
9'	Light brown, fine to medium SAND, trace gravel, trace coarse sand, trace (-) silt, damp	E	--	--			
	End of Exploration at 9'						
10'							
11'							

TEST PIT PLAN	EXCAVATION EFFORT	BOULDER/COBBLE CLASS	PROPORTIONS USED	GROUNDWATER CONDITIONS																									
<div><div>3'</div><div>6'</div><div>N</div></div>	<div>Easy .....E</div> <div>Moderate .....M</div> <div>Difficult .....D</div> <div>Very Difficult .....V</div>	<table><thead><tr><th>Type</th><th>Size</th><th>Abbr.</th></tr></thead><tbody><tr><td>Cobble</td><td>3" - 6"</td><td>C</td></tr><tr><td>Small</td><td>6" - 18"</td><td>S</td></tr><tr><td>Medium</td><td>18" - 36"</td><td>M</td></tr><tr><td>Large</td><td>36" and Larger</td><td>L</td></tr></tbody></table>	Type	Size	Abbr.	Cobble	3" - 6"	C	Small	6" - 18"	S	Medium	18" - 36"	M	Large	36" and Larger	L	<table><thead><tr><th>Term</th><th>Relative Quantity</th></tr></thead><tbody><tr><td>and</td><td>35% - 50%</td></tr><tr><td>some</td><td>20% - 35%</td></tr><tr><td>little</td><td>10% - 20%</td></tr><tr><td>trace</td><td>10% or less</td></tr></tbody></table>	Term	Relative Quantity	and	35% - 50%	some	20% - 35%	little	10% - 20%	trace	10% or less	<div>GW Encountered?: No</div> <div>GW Depth (ft): N/A</div> <div>GW Elevation (ft): N/A</div> <div>Elapsed Time (min): N/A</div>
Type	Size	Abbr.																											
Cobble	3" - 6"	C																											
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and	35% - 50%																												
some	20% - 35%																												
little	10% - 20%																												
trace	10% or less																												

<b>Remarks:</b> 1. No indications of Seasonal High Groundwater Observed 2. Infiltration test performed adjacent to test pit at 3.5' below ground surface	<b>PROJECT NO.</b>  <b>3520-01-01</b>
	<b>LOG OF TEST PIT</b>  <b><u>TP-3</u></b>

# Particle Size Distribution Report



GRAIN SIZE - mm.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.4	7.1	6.1	34.7	30.9	18.8	

Test Results (ASTM C 136 & ASTM C 117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
3/4	97.6		
1/2	96.8		
3/8	94.2		
#4	90.5		
#8	86.2		
#16	76.3		
#30	60.7		
#40	49.7		
#50	39.8		
#100	25.1		
#200	18.8		

\* (no specification provided)

## Material Description

B-7 0-5'

## Atterberg Limits (ASTM D 4318)

PL=

LL=

PI=

## Classification

USCS (D 2487)=

AASHTO (M 145)=

## Coefficients

D<sub>90</sub>= 4.2110

D<sub>85</sub>= 2.1035

D<sub>60</sub>= 0.5855

D<sub>50</sub>= 0.4294

D<sub>30</sub>= 0.1982

D<sub>15</sub>=

D<sub>10</sub>=

C<sub>u</sub>=

C<sub>c</sub>=

## Remarks

This sample delivered to lab by client. This sample was washed.

Date Received: 4/29/22

Date Tested: 5/2/22

Tested By:

Checked By: John McGreevy

Title: Dir. of Testing Services

Sample Number: 1910

Date Sampled:

**ALLIED TESTING  
LABORATORIES, INC.**  
Springfield, Massachusetts

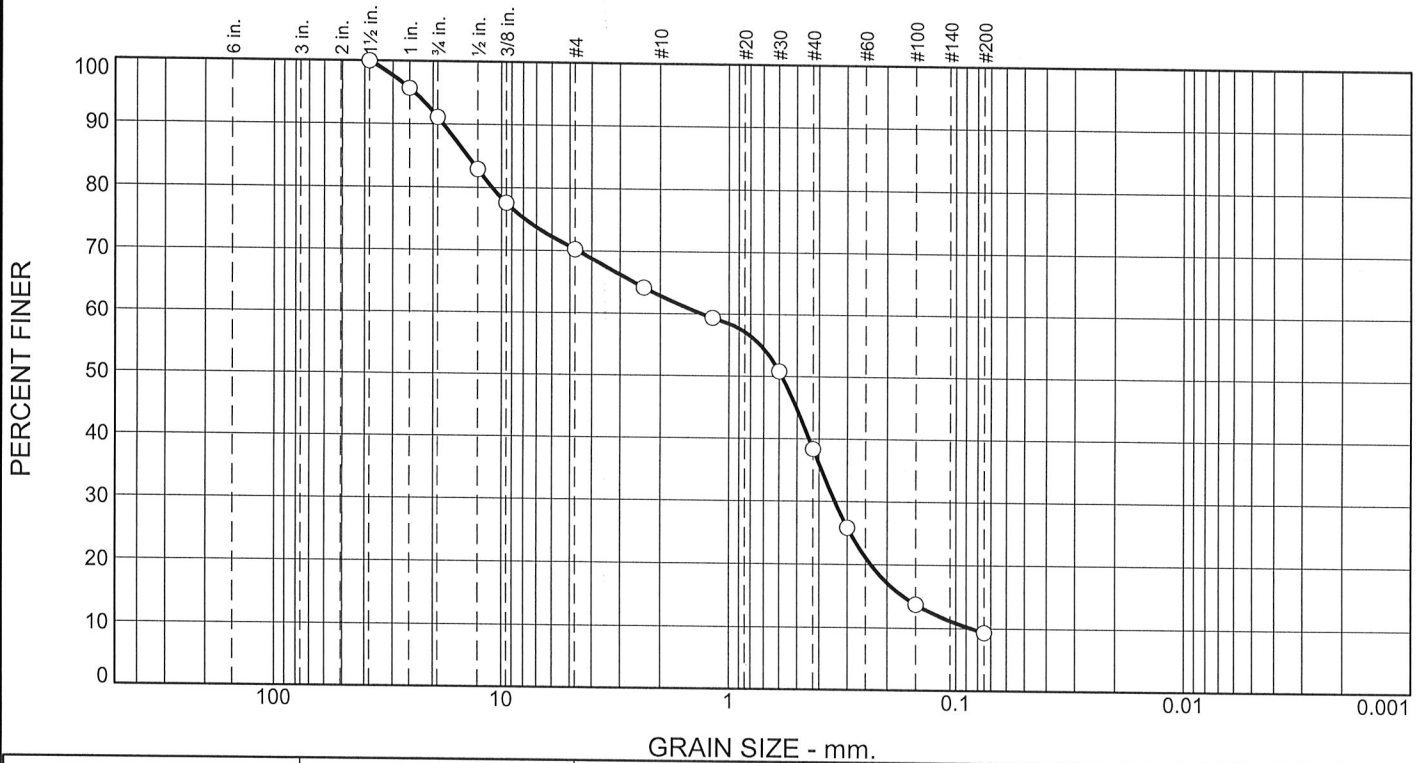
Client: OTO

Project: Northfield ATV

Project No: 3520-01-01

Figure

# Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.9	20.8	7.4	24.5	29.1	9.3	

Test Results (ASTM C 136 & ASTM C 117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1	95.7		
3/4	91.1		
1/2	82.9		
3/8	77.6		
#4	70.3		
#8	64.2		
#16	59.4		
#30	50.9		
#40	38.4		
#50	25.9		
#100	13.7		
#200	9.3		

\* (no specification provided)

## Material Description

B-3 0-5'

## Atterberg Limits (ASTM D 4318)

PL=

LL=

PI=

## Classification

USCS (D 2487)=

AASHTO (M 145)=

## Coefficients

D<sub>90</sub>= 17.9857

D<sub>85</sub>= 14.0872

D<sub>60</sub>= 1.3152

D<sub>50</sub>= 0.5828

D<sub>30</sub>= 0.3407

D<sub>15</sub>= 0.1701

D<sub>10</sub>= 0.0864

C<sub>u</sub>= 15.22

C<sub>c</sub>= 1.02

## Remarks

This sample delivered to lab by client. This sample was washed.

Date Received: 4/29/22

Date Tested: 5/2/22

Tested By:

Checked By: John McGreevy

Title: Dir. of Testing Services

Sample Number: 1911

Date Sampled:

**ALLIED TESTING  
LABORATORIES, INC.**  
Springfield, Massachusetts

Client: OTO

Project: Northfield ATV

Project No: 3520-01-01

Figure